U.S. Department of Transportation
Federal Motor Carrier Safety Administration

OFFICE OF ANALYSIS, RESEARCH, AND TECHNOLOGY

Smart Infrared Inspection System Preliminary Field Test Results

November 12, 2009

Webinar Transcript

Presenters

- Jeff Loftus, Technology Division Chief, FMCSA Office of Analysis, Research, and Technology (ART)

Speakers

- Kirse Kelly, Webinar Host, FMCSA ART
- Bob Foss, Manager of Research and Development, International Electronic Machines (IEM) Corporation
- James McKenzie, Lieutenant, Tennessee Highway Patrol

Description:

Through a research grant from the FMCSA, the International Electronic Machines Corporation developed and tested a Smart Infrared Inspection System (SIRIS) at numerous locations including the FMCSA Commercial Motor Vehicle Roadside Technology Corridor along Interstate 81 in Eastern Tennessee. This webinar will showcase the intelligent capabilities of the SIRIS thermal imaging system, which is now capable of automatically evaluating each vehicle as it passes and, via a combined audio and visual alert, notify inspectors in the scale house of possible issues with a particular vehicle. Jeff Loftus, Technology Division Transportation Specialist, will present the results of the SIRIS system demonstration in April 2009 and follow-on field operational test in August 2009, which evaluated a combined total of over 7,000 vehicles.

PRESENTATION—SMART INFRARED INSPECTION SYSTEM PRELIMINARY FIELD TEST RESULTS

PRESENTATION TITLE SLIDE: SMART INFRARED INSPECTION SYSTEM PRELIMINARY FIELD TEST RESULTS

Laurie (Operator):

Welcome and thank you for standing by. At this time all participants are in a listen-only mode. During the question and answer session please press *1 on you touch-tone phone. Today's call is being recorded. If you have any objections you may disconnect at this time. I will now turn the call over to Ms. Kirse Kelly. You may begin.

Kirse Kelly (Webinar Host, FMCSA ART):

Thanks Laurie. And thanks to all of you who are participating today in our webinar about the Preliminary Field Test Results for the Smart Infrared Inspection System. Today is Thursday, the 12th of November. This webinar is part of a series put on by FMCSA Office of Analysis, Research and Technology.

As Laurie mentioned, time permitting, all questions will be answered at the end of the call. You can submit questions in the **Q&A Box** which is on the lower-left side of your screen by typing a question and just clicking the arrow. You can do that throughout the presentation. At the end of the call you'll be able to both submit questions online and ask questions over the phone line. All questions will be answered at the end of the phone call rather than throughout.

Please note—you are going to be able to download a copy of the presentation at the end of the webinar. If you have to leave early, you can return to this Web site or you can go to the FMCSA ART Web site at a later time, and those slides will be available.

Members of the trade or local media who are participating today are asked to contact the FMCSA Office of Communications. That phone number is (202) 366-9999. You can contact them at the conclusion of the webinar if you have any questions. Once again, that's the Office of Communications and that number is (202) 366-9999.

Finally, for anyone who may have a smaller screen and the virtual meeting room is on the upper-left side of you screen, you may want to try **Full Screen**. You can see at the top-left side there's a word **Meeting** at the very top there. If you chose **Manage My Settings** in that list, and click on **Full Screen**, that will make it a little larger for you.

Let me go ahead and turn you over then to Jeff Loftus who is the Chief of the FMCSA ART Technology Division.

Jeff Loftus (Technology Division Chief, FMCSA ART):

Thank you, Kirse. Thank you all for spending some or your day with us here at FMCSA to hear about the preliminary results that we have from our field testing of the Smart Infrared Inspection System. This effort would not have been possible without the fantastic help and support from the research team lead by IEM of Troy, NY, with support from the University of Michigan's Transportation Research Institute. In the field side of it, we would be nowhere without the Tennessee Highway Patrol as well as great support from the New York State DOT, the New York State Police, and the New Jersey State Police to test this out.

I have about 20 slides I want to share with you on these preliminary results—what we did, why we did it, what were the results, and where we are going from here, as well as a video of what an officer would see in the scale house. This system, basically, is looking to enhance current infrared-based systems that are manual in nature where officers are looking at screens and making screening decisions. This system is fully automated: screens do not need to be looked at directly, but scanning is going on a regular basis of commercial vehicles, trucks and buses, as they approach the array area of cameras. Alerts are provided to officers if temperatures are sensed to exceed operating thresholds set by the system.

That's kind of a quick overview of what this is in relation to existing infrared systems. This was a prototype effort—let's go to the next slide before I get into more of those details.

SLIDE 2: AGENDA

Okay, there it is. I forgot how to advance the slides.

Again, we are going to talk—a quick overview of the system, some of the details, the results, and, most importantly, we have online Lieutenant James McKenzie from the Tennessee Highway Patrol who operates the scales in the Green County area of east Tennessee on I-81 where we did the majority of the testing, and definitely you will want to hear his feedback from himself as well as his officers. We will entertain questions afterwards. We will have contact information as well, if you wanted to follow up offline.

SLIDE 3: SMART INFRARED INSPECTION SYSTEM (SIRIS)

This effort was initiated via a grant, with the goals of identifying in real time faults and failures—not just brakes, but also tires and basic wheel issues—bearings. We are looking to do this along the interstate, and also explore whether or not this system could also provide information that would be useful from a predictive standpoint. We learned early on in this effort that that predictive mode would probably be suited within a fleet where the fleet operators would know the full history of the vehicles, and be able to track trends better and have a better handle on the equipment that is passing by the sensor array. We did the testing, as you can see in these photographs on this slide here, with the camera array on both sides of the ramp approaching the weigh station, in more of an enforcement setting.

SLIDE 4: SIRIS – DETAILS

As I mentioned, this was 3-year grant project that we that we competitively awarded to IEM of Troy, NY. We also—I should say the IEM also received additional resources from New York State Environmental Research Development Authority for taking this concept and looking to do it at even higher speeds.

Let me take a quick moment to share with you some of the components here, where you have—this is a shot of the system with a camera on both sides of the vehicle. This system, in relation to the current manual systems, is really viewing only one side of a vehicle—you have a camera here, camera there, and here's the processing unit. Here are some images of an under-inflated tire that the system captured.

SLIDE 5: SIRIS – CONCEPT OF OPERATIONS

The concept of operations were to measure wheel temperature and segment the temperatures into performance areas. This is kind of a look from a software standpoint. It's looking for circular shapes both from the tire, the wheel, the brake area, and then in this the little red circle, the bearing or wheel area. This is what it actually looks like in practice in the system.

The system automatically flags the items, looking for—or the items meeting certain criteria in terms of an area being too cold or too hot in relation to ambient temperature. It alerts the officer if there is an exceeding of those thresholds. Again, we don't have officers looking at the screen the whole time. This is operating in a fully-automated mode and then once an alert is sensed—I'm sorry, once a threshold is sensed—an alert is sounded within the station. It's not an external alarm, it is within the station.

SLIDE 6: SIRIS – FIELD TESTS AND DEMONSTRATIONS

We did the prototyping in the summer of '07 when we launched this technology corridor in East Tennessee with the great support and involvement of the Tennessee Highway Patrol. We did some field test collection work in New York and New Jersey, as I mentioned earlier, and then earlier in this year, demonstrated the system in a prototype test in the spring where we looked at about 3,000 vehicles. We did more extensive field testing late-July, early-August, where we looked at 4,300 vehicles. We also are planning on installing the system permanently at the Tennessee scales in East Tennessee.

SLIDE 7: SIRIS USER INTERFACE

This is the user interface that an officer sees, and we are going to show a video of how it operates. The system triggers on both wheel ends. If you notice here, you can see this is the steering axle on both sides of the truck. These are the drive axles, and these are the axles for the trailer. It also has a full color camera that takes a picture of the vehicle as it is approaching the scales. If an officer wanted to scroll back and see prior events, they could do that in this area. This system is clicking along, but when an alert is sounded the wheel end is highlighted for a

further look. By the time that alarm is going off inside the scale house, it is showing up on the screen. The officer is actually weighing the vehicle on their static scale and can either go out and do a physical look, or direct the vehicle to the parking lot for a closer inspection. Right now it currently operates up to about 20 miles an hour, and we are looking to expand that with help from the New York state folks, in terms of expanding the speed.

SLIDE 8: OPERATIONAL TEST ESSENTIALS

As mentioned a few times, we did the work at the Green County weigh station which is part of a technology corridor that we established in partnership with the Tennessee Highway Patrol. We did the testing in late July. Again, we would not have even been able to even have this discussion without the great support from Lieutenant McKenzie and his troopers there.

SLIDE 9: OPERATIONAL TEST PROCEDURES

In terms of the procedures, during the two-week period, every vehicle was identified and diverted into the scales. The electronic screening system was turned off. There was a message sign at the—right before the censor array on the on ramp—that said, *10 Miles an Hour*, which delivered about 20 miles an hour for the vehicles coming up by the array. Again, we have brakes—sorry, we have trucks leaving the highway, applying their brakes on an exit ramp into the scale house. About half way down the exit ramp—that is where the system is located. All of the vehicles were directed over the static scale. The reports are printed off to the inspector. For all of the brake flags that were done, the site also has a performance-based brake tester and an inspection pit. All of the vehicles that had brake flags were put through a performance-based brake tester, as well as the full Level 1 inspection. For tire and bearing flags, those vehicles were subjected to a Level 2 inspection, which is a vehicle inspection.

SLIDE 10: TEST PROTOCOLS – BRAKE FLAGS

I am going to turn it over to Bob Foss from IEM for the next few slides just to talk in a little more detail on the flags for both the brake flags and the tire flags to kind of augment some of the general descriptions that I am providing. So Bob, why don't you take it from here for the next slide or two?

Bob Foss, Manager of Research and Development, IEM Corporation:

Okay. The way that we worked with brakes here is that the fundamental aspect of our system works at looking at the overall variability in brake temperatures across all of the wheels on the vehicle, and that is then compared to what the ambient temperatures are, and also to the relative temperature of the brake areas on the same axle. So it is a little bit of a complex algorithm that is going on to manipulate all of these different measurements, but in the end, it seems to work out fairly well. We are looking specifically, if you were to look back to the slide that Jeff showed of the segmented wheels, we have broken out the areas that are—oh, you are going to go back there?

SLIDE 5: SIRIS – CONCEPT OF OPERATIONS

This slide here, the image that shows the three areas that we are looking at—basically, we are looking at temperatures within those various circles. So the brake area is the sort of the central correlate of the three circles there. I think you can go ahead now to the other slide.

SLIDE 11: TEST PROTOCOLS – TIRE AND BEARING FLAGS

Similarly, when we look at the tire area, this is also concerned with the relative temperature of the tires with respect to one another, as well as with respect to ambient temperature.

With bearing flags, this is largely based on a measurement of the ambient temperature—relative to the ambient temperature for each wheel.

SLIDE 12: SIRIS VIDEO

Jeff Loftus, Chief, Technology Division, FMCSA, ART:

Now we are going to show you a video and I will invite Bob to augment how I am going to describe it. Let me turn over the mouse to Kirse so we can play this.

Bob Foss, Manager of Research and Development, IEM Corporation:

The video that we are going to see here is showing—the first few moments of it are showing the system being set up to accept data, so you are seeing some things that are happening. Up at the top, the menu choices are being made, and then the system will get into showing a vehicle. As the vehicle comes into the system, the identification camera selection is shown, and as the vehicle passes through the system, the wheels are imaged, and then, almost in real time, you are seeing immediately an alert is being sounded. If we had audio here, you would be hearing an audio alert that would draw the attention of the inspectors to the system. I would point out that the user interface can be put in what we call an alert-only mode where the system literally just sits quietly in the background and does not draw any attention or anything unless a vehicle is being flagged, at which point in time you would get this screen which would show up. You would get an audible alert, and then the inspector could come over and take a look at it and make a final human decision as to whether or not that vehicle should be inspected or not. I guess that's it.

Jeff Loftus, Chief, Technology Division, FMCSA ART:

The only thing I wanted to highlight and add with the calling up again was the fact that our friends at the Tennessee Highway Patrol kind of chose kind of the submarine attack alert which I thought was really great. And then, in all seriousness, the other thing that was interesting here is that you can see the wheel-end temperatures here, and the ones that are exceeding the threshold for either being too cold or too hot because obviously—this one is very dark and looks like cold—cold temperatures that are under-exceeding the threshold are highlighted here as well. And then, one thing else is that if an officer was to click on one of these images, then they could take

their cursor and get an actual reading of the pixel-sensor data of the aspects of the image. So, these are just some of the other highlights.

Bob Foss, Manager of Research and Development, International Exchange Machines

Similarly, you can click on the vehicle identification image, up to the—the one on the left side, and that would enlarge that to full size, which is sufficient to be able to read the license plate on it if you needed to read.

In that little table of the measurements that you were pointing out Jeff, that one currently is showing the brake temperature. There is a drop down menu there that would allow you to, for instance, if a vehicle was to be flagged for tire temperature, you could change that from brake. We leave it in brake because by and large we get—by far the largest percentage of flagged vehicles are for brakes, so we leave that by default the brake mode. But if you wanted to look at tire temperatures, it is simply a case where you click on the drop down menu and select **Tire** and it would give the same table of information, but with tire data.

SLIDE 13: PRELIMINARY RESULTS

Jeff Loftus, Chief, Technology Division, FMCSA ART:

We are going into the preliminary results from the field test that was conducted in late July, early August, over a two-week period. There were over 4,300 trucks scanned by the Smart Infrared Inspection System. About 360, or eight percent, were flagged by SIRIS; 328 were flagged for brakes, about 34 for tires, and a couple for bearings. Three hundred five were subjected to vehicle inspection, and of that number, about 63 percent were put out of service for a reason related to a SIRIS flag. For all violations, or any violations, I'd say, including out-of-service violations, as well as any violation, the number went over 75 percent of the vehicles that were flagged had this kind of problem. So it's not 75 percent of the 4,300, but it is 75 percent of the vehicles that were flagged and then subsequently inspected.

We were—and again, this was a research prototype grant that was done. We didn't think this—we didn't know if this could work or not. We were very pleased with the way this prototype was functioning, and that's why we wanted to share these preliminary results to a wider audience. During the Q&A period we can easily go back and forth into the details if you want to ask a specific question.

SLIDE 14: INSPECTION RESULTS

Looking at the inspection results, as noted, over 300 were conducted of the flagged vehicles. For brakes, over 63 percent were put out of service. For tires, 62 percent were put out of service, and for bearings, there were two—one was put out of service and one wasn't. The overall hit rate was comparable to the manual system in its application, but keep in mind, the key difference is that it is not as labor intensive because it is operating completely autonomously, and it is looking at both sides of the vehicles on an ongoing basis. Bob did you want to add anything?

Bob Foss, Manager of Research and Development, IEM Corporation:

No, I do not have any further comments.

Jeff Loftus, Technology Division Chief, FMCSA, ART

Okay.

SLIDE 15: BRAKE RESULTS

On the brake results, this is another look at the data. The item to keep in mind is the types of brake flaws detected in terms of—and these are the wheel ends, the number of wheels involved with these vehicles, but in terms of brake failure and operative brakes—cracked pads, cracked linings, air leaks, and other issues. I think the diversity and the range of problems that the system detected was very interesting, and that was further validated and detected by the manual—physical inspection by the officers.

SLIDE 16: TIRE RESULTS

Similarly, on the tires, there is research that correlates seeing tire debris on the highways, as well as it being thrown around the highways with under inflation and hot tires. We are excited that this could be a screening tool to potentially reduce that problem. When the system flagged a vehicle as a hot tire, a Level 2 inspection was conducted. An air gauge was put on the tire—both the outer tire and the inner tire—and then also, the airbag was checked, because in some cases the tires were fine, but the airbag was deflated.

SLIDE 17: BEARING RESULTS

In terms of bearings, this is a very dangerous condition with bearings overheating. When the two vehicles that had this issue were encountered, officers had a handheld infrared thermometer to gauge the temperature, and one of them had an oil leak in the wheel bearing. That was a very interesting finding to note.

SLIDE 18: STATE ENFORCEMENT FEEDBACK

Now I would like to invite Lieutenant James McKenzie to share his insights and perspective on this Smart Infrared Inspection System. Here is a picture of his facility in east Tennessee along I-81 south. So if you are ever traveling in that neighborhood of the country, stop on by and say hello. Without anything else, I am going to turn it over to Lieutenant McKenzie.

James McKenzie, Lieutenant, Tennessee Highway Patrol:

Yes, we tested this thing on two occasions down here, and Bob worked real hard to make it like we requested—officer friendly. Any kind of new tool that you come up with that is not officer friendly is not going to be utilized to its fullest potential. This last prototype that he set up for us

was extremely officer friendly. The officer does not even have to pay attention to it. It sends out an alert, it takes a picture of the truck, it takes a picture of all five axles, and it highlights what is wrong. All you have to do is turn around and look at the screen, walk out the door, and go right to where it says there is a problem. As I said, he made it extremely officer friendly. Once you do that, it is going to be used every day, every shift, and you're going to find defects. I was very pleased with that fact because nobody likes a gator out there on the interstate. With this thing, you can about eliminate them coming down the highway. Another thing we found out, is it also helps detect busted airbags. Because if you have a busted airbag on axle four, then axle five is going to have to carry all the weight of the trailer and the cargo, which is going to lead to hot tires. Then, as I said, we were very pleased with it. The brake part of it is a whole lot of officer discretion. You have to look at it. The cold brakes are a better indicator than the hot brakes were to us, because if you've got a cold brake, you know that brake is not working. Then again, it takes 20 percent of the brakes to meet that criteria before you place them out of service. You start seeing that more if you watch the machine. Because it seems like companies anymore—I don't know whether it's economic value or their moral standings—they're looking to see if "I can get one more trip out of those brake pads." If "I can get one more trip out of those tires." This machine highlighted everything that we would be looking for on an inspection anyway. Basically what it done, was slung all the work out of it. We were very pleased with the last prototype and enjoyed working with it. That is about all I have to say about Bob's fancy machine. We're ready—we're set up and ready to have it permanently installed tomorrow if you bring it back, Bob.

Bob Foss, Manager of Research and Development, IEM Corporation:

We'll be there in a couple of weeks.

James McKenzie, Lieutenant, Tennessee Highway Patrol:

Okay.

Jeff Loftus, Technology Division Chief, FMCSA, ART:

Thank you, Lieutenant McKenzie. We appreciate—again, we would not be here today without your help and support, and that of the officers that really did a fantastic job in a short amount of time for the system.

James McKenzie, Lieutenant, Tennessee Highway Patrol:

Well, I am into the enforcement end of it of course, and you are into making sure trucks are safe, but you can put them both together with this machine. You can take unsafe trucks off the road and still do you enforcement activity, because we found out that a lot of drivers that don't take care of their trucks don't take care of their log books, don't take care of their driver qualifications, and it just seems like it all goes hand-in-hand. Once you find a junky truck, the icing just keeps on piling up on top of that cake.

Jeff Loftus, Chief, Technology Division, FMCSA ART:

I just have a couple more slides, and then we can turn it over to the question and answer period. We've got written questions and also the ability to ask a question via the phone. Kirse and Laurie will go into those details.

SLIDE 19: SIRIS NEXT STEPS: RESEARCH GRANT

In terms of some next steps, we are going to finish the analysis of the field test results and refine the roles to reduce some of the flags that did not turn out to have problems, and increase the out-of-service rate. We are going to publish all the findings in a final report. Since this effort was done with your taxpayer money, all of the results will be available, the data, the software code, and the analytical work by our friends at the University of Michigan Transportation Research Institute. *[Editor's Note: Correction—the software code will not be available to the public.]* As was mentioned a few times, we are permanently installing the system along the technology corridor that we have established with Tennessee.

SLIDE 20: SIRIS NEXT STEPS: FOLLOW-ON ACTIVITIES

We are going to do some additional refinements—and I believe—here it is, some additional items. A key item here is to develop and publish performance specifications so that any other interested State or fleet operator can use these open, available specs to procure a Smart Infrared System. That will increase competition in that market, and will keep the costs in line with those things. We are excited to provide that kind of technology transfer function so that other interested States and carriers that want to use this technology can, and we'll know that it meets our performance requirements. As was also mentioned, we are going to integrate it into the Tennessee Highway Patrol, and they are going integrate it into their activities. We are going to continue to do follow-on testing and some longer term safety outcome-based research and test work with the system that is going to be permanently installed at the station.

SLIDE 21: CONTACT INFORMATION

Also, I am going to be transitioning this work to my colleague, Chris Flanigan, who is here at the FMCSA Technology Division. Here is his contact information. He is on the line as well. That is pretty much all of the materials that we wanted to share with you. We have about 20 minutes or so to answer your questions. Let me transition to that, or actually let me turn it over to Kirse so that it is done the right way in terms of transitioning to the Q&A part of the program.

[31:17]

QUESTIONS AND ANSWERS

Kirse Kelly: Okay, thanks a lot, Jeff. We're open for questions, so if you would like to ask a question, you can just type in the space at the bottom in that Q&A box that's on the left side of your screen, or you can ask questions over the phone. Press *1 and state your name and company to the recorded message. And when your line is opened, Laurie, our phone operator is going to announce you by name, so please state your name clearly for proper pronunciation. She mentioned also to make sure to remind you to take your phone off mute. Sometimes people forget that and we can't hear their questions. Questions are going to be answered in the order that they are received. As mentioned at the beginning of the call, please note you will be given an opportunity to download a copy of the presentation at the end of the webinar. If you have to leave early, you can return to this Web site at a later time and the slides will be available. Okay, I'll turn it back over to you, Jeff.

Jeff Loftus: Okay. We have several written-in questions. Before we go there, I was just curious if anyone wanted to ask an audio question for starters.

Kirse Kelly: Are there any on the line Laurie?

Operator: I have no questions in the queue at this time. And when you record your name, also include your company name. Thank you.

Jeff Loftus: Okay. I am just going to read the question. I appreciate you all identifying yourself asking the question, but I am not going to call out who asked it. I guess I could, but I think that more important is just the question.

Question: ***When you refer to "any flaw found" is this the only flaws related to brakes and tires, wheels, or does it include other flaws as well (e.g., lights, cargo securement, driver violations, etc.)?***

Bob Foss: I can answer that Jeff. When you were reading that, I was thinking somebody is going to read it that way. It refers to flaws that could be directly related to what we were measuring. So no, it does not include driver logbooks or lights out, or things like that. It could include cargo securement. I do not believe that we had any that were. If a load was improperly loaded—unbalanced—that could cause an issue that we would see, but I don't believe that in this particular set of numbers that there were any situations like that.

Question: ***Slide 14: what was the percentage for trailers versus power unit for brakes?***

Jeff Loftus: Do we have that number Bob?

Bob Foss: I do not have that number, so I'm going to note that down. I certainly can get that number easily enough, but I do not have it right now.

Jeff Loftus: Okay. What we can do as well, is we can post some of the answers to the ones that were asked that we did not have the answers for.

Question: ***Why was brakes used to trigger a Level 1 inspection?***

Jeff Loftus: That is kind of an approach question.

Bob Foss: I think the answer to that question is that that's the only way that we can confirm whether or not there was a problem with the brakes—is by looking, by doing a Level 1 inspection. If I am understanding the question correctly, that would be my answer. Do you understand it that way, Jeff?

Jeff Loftus: I believe so. If we did not answer that question, please elaborate and send us another question. I will search for that, or the person.

Kirse Kelly: Or you could dial *1 and you can elaborate over the phone.

Jeff Loftus: Yup, you could do that too.

Question: ***Are the temperature thresholds specific to brakes calculated in the algorithms based upon the expected increase of temperatures from the vehicle coming off the highway speed to the max 20 miles per hour speed?***

Bob Foss: I think the simple answer is no. The algorithm is entirely based on relative temperatures of all the wheels on the vehicle regardless of—I think there is an implicit question behind that that we were sort of saying, "Okay, we have a vehicle that is going 70 miles per hour on the highway, and in order for it to get down to 20 miles an hour or 10 miles an hour or whatever, it is going to be on the brake for so long and that is going to heat up the brakes so much," no, there is nothing like that going on in our assumptions or in our algorithm for that. We were simply looking at all of the temperatures on all of the brakes, looking at the variability of those temperatures, and then based on certain comparisons of individual—once we have said that a vehicle looks like it's got a problem then we try to address what the nature of that problem is, what wheels are associated with creating that problem, and that's done by looking at the temperature of particular wheels with respect to the opposite axle and with respect to ambient temperature.

Jeff Loftus: Okay. Are there any questions pending on the line for the audio questions?

Operator: I have no questions in the queue. Again, if you would like to ask a question, please press *1 and record your name and your company name.

Jeff Loftus: Okay. We've got lots of written questions, and that's fine.

Question: ***Was the data and results compared to any data that would be normally collected, or was more equipment flagged and put out of service because of the system then without?***

Bob Foss: Let me answer that question. The test did not involve doing a comparison of using, for instance, the same inspectors over the same period of time, doing inspections without the system—if that is coming close to addressing the question. I can't really say whether or not—I can say that it's probable that they put more vehicles out of service based on this tool being there than they would have, but I think that the reason for that was because the system is screening out vehicles that are more likely to get put out of service.

Jeff Loftus: Again, keep in mind, the system is scanning the vehicles for temperature-based anomalies on wheel ends relative to the other wheels on the same vehicle. The other part that also needs to be kept in mind is that a full inspection pit was used to conduct the inspections and we actually have some data from the technology corridor that shows that when you are using a pit versus using creepers, you obviously have more access to the full underside of the vehicles than you would with creepers. So that is something that should also be kept in mind.

Question: ***Is the weigh station static only, or do you use weigh-in-motion weighing? If so, did you sort trucks to static scale based of hits from SIRIS?***

Jeff Loftus My understanding is that this does have weigh-in-motion, the scale house has weigh-in-motion, but it is on the ramp, and I think it was—wasn't it after the SIRIS array?

Bob Foss: No, it's before. But the test protocol that we were using we set the—not to get into a real complicated discussion of this—but the general procedure was, as long as we had officers available to inspect vehicles, we were bringing 100 percent of the vehicles off of the interstate and through our system regardless of whether they were okay on the rim or okay on their speed or whatever the other pre-screening tools that were being used there. All of the vehicles were brought across in front of our system, and because of that, they were also being put on the static scale.

As soon as we had enough inspectors—we had enough vehicles backed up at the pit and all of the inspectors that were working for that shift were busy—we would return the system back to allow the bypass of the scales to happen according to their normal procedures.

Question: ***Will there be funding available to expand this program? If yes, when?***

Jeff Loftus: It is my desire and goal if the numbers continue to show these results, to find resources to expand the program. A key piece of that approach will be the development of the specifications and also working with folks here in the State programs division, to oversee the Motor Carrier Assistance Program to

see if it could be considered an eligible expense. Right now, manual-based infrared screening systems are eligible expenses, but we need to do additional fine tuning to this prototype, and develop the performance specs, I believe, before we can make it eligible. In any event, I don't hold that decision, but that's our goal, is that if everything continues on the path that we are on, it could be eligible and I would think it would probably be in the—we'll probably have the specs done in the spring/summer timeframe of 2010. We'll try to do that faster, but it depends on some other factors. I am not completely up to speed on the State side—on the grant submission timings—but I would think it would probably be more in line with the 2011 grant submission time frame because I think the 2010 plans are probably already in and being put in motion. Luke Loy, you are on the line, do you have—can you add to that?

Luke Loy: On whether it would be eligible for MCSAP funds, is that the question?

Jeff Loftus: No, more on the spec timing.

Luke Loy: Oh, on the spec timing. Yeah, I think that would probably be about correct—that that can be generated probably before 2011. That's pretty quick, but it should be able to be done.

Jeff Loftus: Again, there are lots of caveats, but that is our goal.

Question: ***How did you come up with the temperature range for alarms and flags?***

Jeff Loftus: I will defer to you on that one, Bob.

Bob Foss: In 2008, we did a number of field deployments in New York State and New Jersey, and collected a fairly substantial amount of just raw data where we had the temperature data from our system, and we had Level 1 inspection reports. Then that information was processed and analyzed by the folks at UMTRI, and that resulted in a set of correlations between what we were seeing in terms of the thermal data, and the results of the Level 1 inspections. Then we instantiated them—I hate to use that word, "instantiate," but we converted those correlations into a set of rules that drew some conclusions and allowed us to implement the system and it works today.

Question: ***When do you expect the final report to be available?***

Jeff Loftus: We are going to be receiving the draft final in the February 2010 timeframe. Then we will do our review and internal sign-off. Hopefully, by the spring or summer, depending on getting through the signature queues, but our hope is to get it by late spring/early summer 2010 for folks to look at it. But with that in mind, you can contact us directly, or Bob Foss directly, if you have more detailed questions regarding the technology and the "who's and how's." But we're not going to release the final data until that timeframe.

Question: ***How did you get trucks to use their brakes before reaching the camera?***

Jeff Loftus: Well, again, keep in mind that we put the cameras on both sides of the exit ramp to the weigh station in Eastern Tennessee. So all trucks were being diverted into the weigh station and they were applying their brakes in order to stop and also in order to be weighed by the weigh station. This is a pre-screening site and that system was shut off temporarily so all the vehicles, whether they were in the prescreening program or not, were diverted into the scale house.

Question: ***Please describe Level 1 and Level 2 flags.***

Jeff Loftus: I can't think of a better person to describe that than Lieutenant McKenzie, who I hope is still on the line.

Lieutenant James McKenzie: Yes I'm here.

Jeff Loftus: Would you mind explaining the difference between Level 1 and Level 2?

Lieutenant James McKenzie: A Level 2 inspection is a walk-around inspection. A Level 2, you actually go under the truck, collect brake measurements, and those types of details. *[Editor's Note: Correction—going under the truck is done in a Level 1 inspection.]* If it indicated a tire or bearing has been the reason for the alert, a Level 2 is sufficient, because you can gauge the tire, take your portable infrared to check the bearings and do all that without going under the truck and collecting the brake strip measurements and stuff. Now if it was a brake, the only way we could get the data is to do a complete Level 1 on it because that is the only time that the brake data is collected.

Jeff Loftus: Okay. Thank you, sir.

Question: ***Do the officers use all of the information on the screen?***

Jeff Loftus: What was your experience with that, Lieutenant McKenzie?

Lieutenant James McKenzie: Well, as I said, we checked every one of them that indicated tires and indicated bearings; those are what you might call priority user checks. Now, if we had a truck come down there and it only alerted on one cold brake, then that is an officer's discretion. Because as I said, you could take that mouse, and you could click, and it would tell you the average temperature of all of the other brakes. And as I said, just one brake out of adjustment does not put a truck out of service. We were looking for the dangerous vehicles on the highway. That is an officer's call. Now, if you get two or three alerts, then of course you want to check that truck because then his braking ability is greatly decreased. But as I said, that is an officer's call; that's one place he has some discretion. When he looks at that thing and if it alerts on one cold brake and everything else looks normal, then there might not be a reason to check that

truck. There is always a reason noted in the remarks of that inspection, but you might not want to do a full Level 1 on it if it is just indicating one cold brake or whatever.

Jeff Loftus: Okay. So it seems to me that—and I believe, Bob, that you collaborated with the officers in creating the interface.

Bob Foss: Yeah, I think we would have to go back to our first stay down there back in 2007, and I remember sort of a back-of-the-envelope discussion with Lieutenant McKenzie about what he would like to see. I think that his kind guidance in that regard—we hope that translated into what we are giving them. I would say in answer to the question—I heard it a little bit differently. The question I think said, "Does an officer need to use all of the information on the screen?" And I think the answer to that question is no, because there is a lot of other information on that screen that is more system-related information, like the inspection number. It gives you some idea of what the ambient temperature is, and relative humidity; there are some basic system parameters that are listed on that screen that the officer really doesn't need to pay much attention to ever.

Jeff Loftus: Okay. Thank you, thank you. Any questions for the audio side of it—any audio questions in the queue?

Operator: I have no questions in the queue at this time.

Jeff Loftus: Okay. We're going to go a few minutes over 2 (p.m.) if that's okay with folks, since we started a few minutes after 1 (p.m.) for the webinar. I've got a whole bunch of questions here that we have not gotten to, but what we will do is we will save these questions, and I believe we have your e-mail address, and we will e-mail your—we'll answer your question and e-mail it directly back to you, so we are responsive in that manner.

Question: ***Is the system available to the carrier to purchase?***

Jeff Loftus: I would say that is possible—

Bob Foss: Sure.

Jeff Loftus: Sure. It is a safety tool that if a fleet wants to incorporate it and use for their own operations, then definitely. And Bob's chiming right in, "Sure, we want to sell those to carriers, as well." Well, if you think about it, with performance-based brake testers—those were purchased by both carriers and states.

Bob Foss: I'm sorry, I was talking over you and I apologize.

Jeff Loftus: I know you can't control your excitement on that question.

Bob Foss: I was just going to say that we have talked to a number of carriers from the early stages of this project. Yes, I do think there is some value in putting this at a fleet facility of some sort and really using it. We are talking about looking into this trending if there is something that we could do to begin to watch patterns over time. We have not been able to collect much data on that to date, but it certainly is something that we would like to pursue.

Question: ***How were low-tire issues handled by the Tennessee Highway Patrol? Is there a warning or Notice of Issue given to the driver or company?***

Jeff Loftus: So there are two questions: How were low-tire issues—as in, I guess, hot-tires or low tire-pressure issues—handled by THP, and is there a warning or Notice of Issue given to the driver or company?

I think that's yours, Lieutenant.

Lieutenant James McKenzie: On the low tires, if we went out and gauged them and they were low, if they fell into out-of-service criteria with less than 50 percent of the rated air pressure, that tire was placed out of service and it had to be repaired before he left the scales. If it did not fall into the out-of-service criteria, it was still noted on the safety inspection as a low tire. Some of them—on the hot tires we found, it wasn't a problem that we could deal with. I remember one of them; we had a brand new tire situated beside a worn tire. You had probably an inch difference in tread depth. The new tire was actually carrying most of the weight on that axle. You run into those things where there is nothing in the book that covers that, and you have to just let it roll on. If it is an air pressure issue that fell into the out-of-service criteria, then the tire was placed out of service and repairs were made before it entered the public roadway. If it was low and did not fall into the out-of-service criteria, it was noted on the inspection for the driver to correct.

Jeff Loftus: Okay. I think that answers the question.

Question: ***What is the estimated cost of this system, estimated life, and estimated cost of operation?***

Jeff Loftus: I've been waiting for this one. I'll throw it over to you Bob since, I am sure you've given—

Bob Foss: There are a lot of variables associated with the cost of the system. To give a flat out answer to what that cost will be I find to be extremely difficult, because it depends on whether we are talking about a system that is going to be fielded permanently, or whether it's something that is going to be transported from site-to-site, lots of different variables. I am sort of using, kind of like a rule of thumb that I am going to tell people we are probably looking at the rough order of magnitude cost of about $150,000 plus or minus. In terms of life of the system, I don't really have a standard answer to

give to that, but it is like any high technology kind of application. It is not going to be an unlimited life use. I mean, the cameras themselves do have some limitations on the number of times—the shutters have a certain life. The cameras that we're using now, they've got several years under the belt of fairly regular use. I would certainly think that we would be looking at a reasonable expectation of 3–5 years, without any major system break downs or overhauls being required.

Jeff Loftus: Actually, that made me think about something that maybe we should have covered in the slides, but what is the basic configuration of it—we've got two commercial off-the-shelf cameras that are the regular ones, not the ones that are cooled with liquid nitrogen, right?

Bob Foss: Yeah, we're using un-cooled infrared cameras on either side, and then we have one visible camera that is probably one of the cheapest components of the system. Basically, there is an industrial grade PC inside of the control box. We have an ultrasonic detector for vehicle detection; we are currently using optical switches for wheel triggering. Inside the scale house in Tennessee we have a fiber-optical cable that's running from the system back into the scale house, and in the scale house we have the desktop computer that is sort of running the user interface and accepting the data as it comes back in from all of the processing that's taking place out at the roadside.

Jeff Loftus: So from a component level, it is pretty basic, off-the-shelf stuff from a hardware component level.

Bob Foss: Yeah.

Question: ***How would snow and ice affect the inspection?***

Jeff Loftus: I will give that to you, Bob.

Bob Foss: Probably the major issue with snow and ice would have to do with the effectiveness of the current wheel triggers. The snow and ice itself, as long as you're not letting it build up in front of the cameras—if you are getting out there and clearing it out, that would not be a problem. The current triggering system is an optical system that is running pretty much—maybe about an inch or so above the road surface. So if you had any snow plowing activities, or anything like that that could be coming along, there would be a little bit of labor involved in coming down and clearing out to make sure the sensors would not be buried by ice and snow. Aside from that, there is nothing inherent, and this system would work just fine.

Question: ***Were all of the vehicles that were flagged for brake issues—were they all drum brakes as opposed to disc brakes?***

Bob Foss: I don't know the answer to that question. Lieutenant McKenzie may have some thoughts on that. Right off the top of my head, I don't know the answer to that. I suspect mostly drums.

Jeff Loftus: Lieutenant McKenzie, you still with us?

Lieutenant James McKenzie: Yes.

Jeff Loftus: What is your sense? Were they mostly drum brakes or disc brakes for the vehicles that were flagged with brake issues?

Lieutenant James McKenzie: All of them were drum brakes that I can recall.

Question: ***Did you look at embedding the camera in the roadway with a wide-angle lens so only one camera would be necessary?***

Bob Foss: Yes.

Jeff Loftus: Yeah, I think you did. I remember seeing that in the proposal. Why did you move away from that approach, Bob?

Bob Foss: There are a lot of practical issues with doing that. The practical issues are that you can't embed it all the way into the road; if you leave it up even a little bit, the thing is susceptible to getting hit. You can't plow the road—if you are in a snow area you cannot plow it. There are also issues with—the speed of the vehicle, as we know, is a critical element of our ability to capture the wheels to get the temperatures correct. When you put a system down right in the middle of the road—and I understand sort of where this question is coming from, because at least when you do it this way, we are looking at the brake drum and the pads pretty much directly, which is—certainly a desirable element of our system is to do that, but you are so close from where the camera is to where the brake is, and also, there is so much stuff in the way. You have the whole axle and all of the suspension system, and the stuff that's in there complicates the processing that is necessary in order to accurately segment and determine what it is you are actually looking at. So we did look at this. We did not do any formal experiments with it, but we sort of came to the conclusion, after doing some sort of rough modeling, that it was a very difficult issue to resolve, because of the practicalities of having a camera system that has to be at least a couple of inches above the road surface. I guess you could put it in some sort of a plexiglass—I don't know, there might be some optical tricks you could play to get it completely embedded in the road, but then you have the practical issues of keeping that clean. There are just a lot of issues there that sort of drove us away from that solution. But yes, it was considered.

Jeff Loftus: Okay. We are going to take a couple of more questions and then what we will do is we will answer all of the questions, and then take the people's names off that asked them, and then we'll send out the questions and the answers to all of the registrants so that you will have the benefit of seeing what other people asked and what the answers were. I think I mentioned earlier, we would go directly to the questioner, but I think it would be better just to take the names off of the questions, answer them, and then send them out to everyone. So a couple of more questions and then we'll wrap up.

Question: ***Will this system prevent wheel-off incidents?***

Jeff Loftus: That is an interesting question. I mean, we did not experience any of those, so it would be kind of a speculative question. Bob, what do you think?

Bob Foss: Well, it can't hurt. It lends the potential that it might; if we consider sometimes an overheated bearing may open a wheel-off condition. In that regard, we can detect the hot bearings.

Jeff Loftus: Right. So possibly, but we do not know for sure.

Question: ***How does the system examine inboard, dual-wheel defects?***

Bob Foss: Interesting question. When we—I'm trying to think of where—I guess it is from our New Jersey data, the question had come up. I can't remember what venue it was, but at some point, somebody has asked that question, and I had gone back and I did some analysis. I have not looked at our data from Tennessee, from this most recent data, but from the New Jersey data, we found a number of cases where we flagged a vehicle for a hot tire, and we were only looking at the tire on the outside when, in fact, the tire that was underinflated was in fact the inner tire. So the logic is that sometimes the fact that those two tires there that are not doing an equal amount of work, the heat will manifest in the outer tire regardless.

Jeff Loftus: This is going to be our last question and then I will turn it back over to Kirse who has some closing out information. Again, I just want to thank everyone for taking time out of their busy day to get on the line with us so we could share these preliminary results with you.

Question: ***What camera did you use for infrared and does it have color? Is there a reason not to use color for the users?***

Bob Foss: The cameras that we were using for this particular prototype are no longer available, but they are Flir A40s. The question of the way that the image is displayed on the screen is a somewhat complex question. I do not know the technical background of the person asking the question, but yes, we can display it in color. In fact, that is one of the options that is available. You can put it in false color; you can put it in what they call sepia, or—there's like four different color modes that you can select. We certainly leave that up to the

operator—whatever is what they prefer, that's fine. The real issue as far as the flagging is concerned is the flags are not based on the information that is being displayed on the screen. The data from the cameras is 14 bits. There are 14 bits of thermal data associated with the file. The screen is only showing eight of those 14 bits, so there is a lot more information that is being used for the flagging purposes than is being used for display purposes. That is just sort of the inherent part of—display technology has not really caught up to our ability to collect data. Does that answer the question?

Jeff Loftus: Keep in mind, going back to the beginning of this entire project, is that we do not want the officers to be looking at the screens on a regular basis. When an alert is sounded they can look and see that. So it's really a great labor-saver in that regard and one of the key aspects of the design of the system.

With that, thank you Bob and Lieutenant McKenzie, and others on the line—

Operator: Excuse me, this is the coordinator. I do have a question from Washington State DOT. Do you want to take the call?

Jeff Loftus: Okay.

Operator: Your line is open sir.

Question: ***Thanks. I was just curious with the camera—I wrote the one about the color, we have been doing some testing with a 4325 here in Washington, and I found the color was real helpful for when were working with the users, so I wondered if you had that opportunity there or not?***

Bob Foss: Like I said, we do have that capability. We didn't show it to you, but there is an option that's a setup option in the user interface that allows you to select one of four different modes for displaying the image in color; false color is one of them. So it is possible to do that.

Questioner: Okay. I was just curious if the users found a benefit or not.

Bob Foss: Again, that is completely up to the user. From our point of view—this is my major point—is that the flagging is not based on anything that you see on the screen.

Jeff Loftus: Any other questions in the audio queue?

Operator: There are no more questions at this time.

Jeff Loftus: Okay. Like I said, we are going to answer all of the written questions that we have not answered on the line and take people's names off of them and send them out to all of the registrants. It looks like Kirse has called up the evaluation screen, so I will turn it over to her to close out the call. Thanks

again. Thank you, Lieutenant McKenzie and Bob and others for making this a successful webinar.

[1:09:24]

Kirse Kelly: Okay, this is Kirse again, and this concludes the presentation part of our webinar. Before you sign off, please complete the evaluation that you see on the screen. We welcome your comments about this webinar and suggestions for future webinars. Please note, your comments can be viewed by all of the participants in the meeting room, so if you'd like to remain anonymous, just click on the word **Everyone** at the bottom of that chat pod and choose **FMCSA Host**.

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As a reminder, members of the trade or local media who participated in today's webinar are asked to contact the FMCSA Office of Communications if you have any questions, and that number is (202) 366-9999.

On Thursday, December 10th we are hosting a webinar that will give you an Introduction to the Commercial Motor Vehicle Web-based Driving Tips Web site. Registration for that webinar is already open, so you can just go to our Web site and register today. We will also be sending out announcements of this and other webinars, so if you are not yet on our e-mail list, just contact me at Kirse.Kelly@dot.gov and request that your name be added to that list.

So this concludes the webinar. Once again thank you all very much for participating and thanks also to Laurie, our phone operator.

[1:11:13]